FINAL REPORT FOR NAGW-4478
"The Physics of Energetic Electrons and Heating in Solar Flares"

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The funding under the grant NAGW-4478 was intended primarily to support a phase-down of the research work which was carried out under the the earlier grant NAGW-2452 (April 1, 1991 - June 30, 1995 - Principal Investigator: Kinsey A. Anderson - "Studies of Energetic Electrons in Solar Flares through Analysis and Interpretation of Correlated Observations"). The following report, therefore, covers the combined award period for both the grants, May 1, 1991 - August 31, 1996. The objective of this research was to determine the characteristics of the acceleration, propagation, and confinement of energetic electrons in solar flares through an analysis and interpretation of the existing correlated observations of solar flares. The observational data to be included were the stereoscopic observations of the directivity and spatial structure of the hard X-ray sources in solar flares made with instruments aboard near-Earth and interplanetary spacecraft and observations at optical and other wavelengths made at ground-based observatories.

The following solar flare data were examined: (1) Hard X-ray observations made by the interplanetary spacecraft International Cometary Explorer (ICE), Pioneer Venus Orbiter (PVO), and Ulysses; (2) Hard X-ray observations made by the near-Earth spacecraft Third International Sun Earth Explorer (ISEE-3), Solar Maximum Mission (SMM), and Yohkoh; (3) White light flares observed at the Sacramento Peak Observatory; (4) Radio bursts observed by the Nançay Solar Radio-heliograph in France; (5) Related soft X-ray, radio and optical data listed in the Solar Geophysical Data published by NOAA.

The analysis of the above data provided new and significant results regarding the following aspects of solar flares: (1) Directivity of hard X-ray sources and the implied beaming of energetic electrons; (2) Impulsive hard X-ray sources in the the corona and their implications regarding the confinement of energetic electrons in the high corona; (3) Dynamic evolution of the accelerated electrons in the coronal magnetic trap; (4) Relationship of the white light and hard X-ray emissions and implied characteristics of the white light source and the energy transport by non-thermal electrons; (5) Statistical frequency distributions of hard X-ray and electron energy parameters obtained from an analysis of several thousand hard X-ray flares.

Details of the scientific results obtained through this research are described in the published papers listed below.

Publications:

Kane, S. R., McTiernan, M. J., Loran, J., Fenimore, E. E., Klebesadel, R. W., and Laros, J. G., *Ap. J.*, **390**, 687, 1992.

Neidig, D. F., and Kane, S. R., *Solar Phys.*, **143**, 201, 1993.

Kane, S. R., Hurley, K., McTiernan, J. M., and Sommer, M., *Adv. Space Res.*, **13**, 241, 1993.

Bruggmann, G., Vilmer, N., Klein, K. -L., and Kane, S. R., *Solar Phys.*, **149**, 171, 1994.

Kane, S. R., Hurley, K., McTiernan, J. M., Sommer, M., Boer, M., and Niel, M., *Ap. J.*, **446**, L47, 1995.

Bromund, K. R., McTiernan, J. M., and Kane, S. R., *Ap. J.*, **455**, 733, 1995.

Kane, S. R., Hurley, K., McTiernan, J. M., Boer, M., Niel, M., Kosugi, T., and Yoshimori, M., *Ap. J.* , submitted, 1996.